

PROTOZOAN PARASITES OF THE ORTHOPTERA, WITH SPECIAL REFERENCE TO THOSE OF OHIO

IV.¹ CLASSIFIED LIST OF THE PROTOZOAN PARASITES OF THE ORTHOPTERA OF THE WORLD. CLASSES MASTIGOPHORA, SARCODINA, AND SPOROZOA

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This classified list of all protozoan parasites thus far reported for Orthoptera has been assembled for the purpose of making available from one source much information which formerly has been obtainable only by consulting and comparing a large number of books and papers.²

Beginning with class, and continuing down through genus, a short, characterizing description is given for each group. That these descriptions are mutually exclusive will be seen by comparing two groups of the same level, i.e., two classes, two orders, etc.

Under species, certain symbols have been used to relate the data under the various headings. Each reference is numbered and this is the number which is used to refer to that author under the other headings for that species. For example, a synonym followed by (1) indicates that author number (1), above, used that name for the parasite. Further, each host is indicated by a letter and followed by one or more numbers. The numbers, of course, again refer to the authors who studied that host, and the letter is used to refer to the host in the following data. For example, under *Leptomonas blaberae*, the first parasite listed, we find under distribution "Catuche, Venezuela" followed by "(1a)." This means that author (1) above (Tejera) found *L. blaberae* in host "a" (*Blabera* sp.) captured in Catuche, Venezuela. Where more authors, etc., are listed, the method is the same, the number always referring to the author and the letter to the host.

In the lists of references, only works of a monographic nature are cited. This excludes most texts and general works, unless they contain original work in addition to mere compilation. In every case, only the first page of a reference is given, unless it is discontinuous, in which case the separate pages are given.

In the host lists, only the accepted names are used.

For habitat, i.e., the region of the insect in which the parasite was found, only the accepted terminology is used. (References: Comstock, 1930; Imms, 1929.)

Frequently, some localities are omitted under the heading "distribution." This means that the author did not specifically state where his material was collected and where he did his work.

¹Part I: Ohio Jour. Sci., 36: 315-320. 1936. Part II: Ohio Jour. Sci., 39: 157-181. 1939. Part III: Ohio Jour. Sci., 41: 457-464. 1941.

²A bibliography will be included in a continued paper to appear in the next issue of this Journal.

CLASSIFIED LIST

Class 1. MASTIGOPHORA Diesing, 1865.

Possess one or more flagella during the greater part of the life-history, and in the adult state always.

Order 1. PROTOMONADIDA Blochmann, 1895.

Possess few flagella (rarely more than 6), one nucleus, and are usually without accessory internal organs.

Family 1. *Trypanosomidae* Doflein, 1901.

Possess a single flagellum, and are parasitic in vertebrates, invertebrates, or plants.

Genus 1. **Leptomonas** Kent, 1880. Found only in invertebrate hosts, and never developing beyond the *Leptomonas* stage, showing only this and *Leishmania* forms in their life cycle.

Leptomonas blaberae Tejera, 1926.

References: (1) Tejera, 1926, 1382.

Synonymy: Name unchanged.

Hosts: (a) *Blabera* sp.

Habitat: ?

Distribution: Catuche, Venezuela (1a).

Leptomonas sp.

References: (1) This paper, parts II and III.

Hosts: (a) *Parcoblatta virginica* (Brunner); (b) *P. lata* (Brunner); (c) *P. pensylvanica* (DeGeer); all by (1).

Habitat: Hind-intestine, (1a), (1b), (1c).

Distribution: Franklin (1a), (1c); Fairfield (1b), (1c); Champaign (1c); Hocking (1b); Logan (1c); Madison (1c); and Washington (1c) Counties Ohio.

Genus 2. **Herpetomonas** Kent, 1880. Found only in invertebrate hosts, but showing *Leishmania*, *Leptomonas*, *Crithidia*, and *Trypanosoma* types in their cycles.

Herpetomonas periplanetae Laveran and Franchini, 1920.

References: (1) Laveran and Franchini, 1920a, 145; (2) Laveran and Franchini, 1920b, 331.

Synonymy: Name unchanged.

Hosts: (a) *Blatta orientalis* Linnaeus, (1), (2).

Habitat: Alimentary canal, (1a), (2a).

Distribution: Paris, France, (2a); Bologna, Italy, (1a).

Family 2. *Cryptobiidae* Poche, 1913.

Possess two flagella, one of which is directed forward, while the other passes backward and is attached to the surface of the body, and may be raised into an undulating membrane.

Genus 1. **Cryptobia** Leidy, 1846. Found in intestinal canal of fishes and seminal vesicles and spermatophores of molluscs and other invertebrates.

Cryptobia gryllotalpae (Hamburger, 1911).

References: (1) Hamburger, 1912, 216; (2) This paper, under synonymy.

Synonymy: *Trypanoplasma gryllotalpae* (1); *Cryptobia gryllotalpae* (2). (Genus *Cryptobia* Leidy substituted for *Trypanoplasma* Laveran and Mesnil. See Kudo, 1931, 147.)

Hosts (a) *Gryllotalpa gryllotalpa* Linnaeus (1).

Habitat: Hind-intestine, (1a).

Distribution: Heidelberg, Germany, (1a).

Family 3. *Bodonidae* Doflein, 1901.

Possess two flagella, one of which is directed backward as a trailing flagellum.

Genus 1. **Embadomonas** Mackinnon, 1911. Found in the intestine of mammals and insects.

Embadomonas blattae Bishop, 1931.

References: (1) Bishop, 1931, 287.

Synonymy: Name unchanged.

Hosts: (a) *Blatta orientalis* Linnaeus, (1).

Habitat: Hind-intestine, (1a).

Distribution: Cambridge, England, (1a).

Order 2. POLYMASTIGIDA Blochmann, 1884.

Possess three to eight flagella, one to many nuclei, and frequently axostyle or axial filament.

Tribe 1. *Monozoa* Calkins, 1926.

Possess one cytostome and kinetic element.

Genus 1. **Retortamonas** Grassi, 1879. Possess four flagella, one of which trails. Parasitic in the intestine of various insects.

Retortamonas gryllotalpae Grassi, 1879.

References: (1) Grassi, 1879, 448; (2) Grassi, 1881, 153, 161, et. al.; (3) Hamburger, 1912, 216. Synonymy: *Retortamonas gri* (and *y*) *llotalpae*, (1), (2); *Schedoacercomonas melolonthae*, (1); *S. gri* (and *y*) *llotalpae*, (1); *Monocercomonas insectorum*, (2), (3); *Plagiomonas Gri* (and *y*) *llotalpae*, (2).

Hosts: (a) Larval gryllotalpae, (2).

Habitat: Hind-intestine, (2a).

Distribution: Rovellasca, Italy (?), (2a).

Retortamonas orthopterorum (Parisi, 1910) Wenyon, 1926.

References: (1) Parisi, 1910, 235; (2) Hamburger, 1912, 216; (3) Belar, 1916, 243; (4) Wenyon, 1926, 678; (5) Kudo, 1931, 159; (6) McAdow, 1931, 21; (7) Balch, 1932, 237.

Synonymy: *Trichomonas orthopterorum*, (1), (2); *Monocercomonas orthopterorum*, (3), (7); *Retortamonas orthopterorum*, (4), (5), (6).

Hosts: (a) *Ectobia lapponica* (Linnaeus), (1); (b) *Blatta orientalis* Linnaeus (1); (c) *Gryllotalpa gryllotalpa* Linnaeus, (1), (2). Also reported as *Monocercomonas orthopterorum* from *Tipula abdominalis*, a dipteran. (See Geiman, 1932, 173).

Habitat: Alimentary canal, (1c), (1a); Hind-intestine, (1a), (1b), (1c); rectum, (2c).

Distribution: Heidelberg, Germany, (2c); Lombardy, Italy, (1a), (1b), (1c); Trentino, Italy, (1b); Baden, (?), (1b).

Tribe 2. *Diplozoa* Calkins, 1926.

Possess two cytostomes and kinetic elements.

Genus 1. **Octomitus** Prowazek, 1904. Possess six anterior and two posterior flagella. Parasitic.

Octomitus periplanetae Belar, 1916.

References: (1) Belar, 1916, 254; (2) Kudo, 1931, 162; (3) McAdow, 1931, 21.

Synonymy: Name unchanged.

Hosts: (a) "Kitchen-cockroach," (1).

Habitat: Alimentary canal, (1a).

Distribution: Vienna, Austria, (1a).

Order 3. HYPERMASTIGIDA Grassi, 1911.

Possess numerous flagella, a single nucleus, and may have axostyles and parabasal bodies.

Family 1. *Lophomonadidae* Grassi, 1885.

Flagella arise from the anterior end in a tuft. Parasitic in cockroaches and termites.

Genus 1. **Lophomonas** Stein, 1860. Parasitic in the colon of cockroaches.

Lophomonas blattarum Stein, 1860.

References: (1) Stein, 1860, 49; (2) Bütschli, 1878, 258; (3) Leidy, 1879, 204; (4) Kent, 1880-1882, 321; (5) Grassi, 1881, 172; (6) Schuster, 1898, 242; (7) Janicki, 1908, 141; (8) Janicki, 1910, 244; (9) Belar, 1916, 242; (10) Kudo, 1922, 113; (11) Kudo, 1926a, 191; (12) Kudo, 1926c, 504; (13) McAdow, 1931, 15.

Synonymy: *Lophomonas Blattarium*, (1), (5); *Lophomonas blattarum*, (2), (3), (4), (6), (7), (8), (9), (10), (11), (12), (13).

Hosts: (a) *Blatta orientalis* Linnaeus, (1), (2), (7), (8), (10), (11), (12); (b) *Blatta* sp. (5); (c) *Periplaneta americana* (Linnaeus), (6); (d) *Gryllotalpa* sp., (8).

Habitat: Hind-intestine, (2a), (7a), (8a), (8d); colon, (6c), (13?); rectum, (1a), (13?).

Distribution: Europe, (8a), (8d); Germany, (2a); Rome, Italy, (7a); Rovellasca, Italy ?, (5b); Urbana, Illinois, (10a), (11a), (12a); Ohio, (13?).

Lophomonas striata Bütschli, 1878.

References: (1) Bütschli, 1878, 258; (2) Kent, 1880-1882, 322; (3) Grassi, 1881, 177; (4) Schuster, 1898, 243; (5) Janicki, 1908, 144; (6) Janicki, 1910, 244; (7) Belar, 1916, 242; (8) Kudo, 1922, 113; (9) Yakimoff and Miller, 1922a, 9; (10) Yakimoff and Miller, 1922b, 133; (11) Kudo, 1926c, 504; (12) Tejera, 1926, 1382; (13) Lucas, 1928, 172; (14) Weill, 1929, 22; (15) McAdow, 1931, 15.

Synonymy: *Lophomonas striata*, (1), (2), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15); *Lophomonas Striata*, (3); *Lophomonas sulcata*, (4). (*L. sulcata* was distinguished by Schuster from *L. striata* chiefly on the basis of the greater size of the former. Kudo (1926c, 505) intimates that the size and characteristics described for *L. sulcata* are comprehended by those of *L. striata*.)

Hosts: (a) *Blatta orientalis* Linnaeus, (1), (5), (6), (8), (11); (b) *Periplaneta americana* (Linnaeus), (4), (14); (c) *Grylotalpa* sp., (6).

Habitat: Alimentary canal, (4b), (13?); hind-intestine, (1a), (5a), (6a), (6c), (14b); colon and rectum, (15?).

Distribution: Europe, (6a), (6c); Germany, (1a); Rome, Italy, (5a); French Indo-China, (14b); Urbana, Illinois, (8a), (11a); Ohio, (15?).

Class 2. SARCODINA Hertwig and Lesser, 1874.

Capable of changing the body form and forming pseudopodia, both for locomotion and food-capturing.

Order 1. AMOEBIDA Calkins, 1902.

Body unprotected by any shell or skeletal structure. Cytoplasm differentiated into endo- and ectoplasm.

Family 1. *Endamoebidae* Calkins, 1926.

Endoparasitic, with wide zoological distribution.

Genus 1. *Endamoeba* Leidy, 1879. Nucleus spherical or oblong with very thick membrane. Several endosomes. Parasitic in invertebrates.

Endamoeba blattae (Bütschli, 1878) Leidy, 1879.

References: (1) Bütschli, 1878, 273; (2) Leidy, 1879, 204; (3) Grassi, 1881, 184; (4) Schubotz, 1905, 6; (5) Mercier, 1907, 1132; (6) Janicki, 1908, 148; (7) Mercier, 1908b, 943; (8) Elmassian, 1909, 144; (9) Janicki, 1909, 381; (10) Mercier, 1909, 164; (11) Mercier, 1910, 143; (12) Belar, 1916, 242; (13) Kudo, 1922, 113; (14) Yakimoff and Miller, 1922b, 133; (15) Kudo, 1926b, 139; (16) Kudo, 1926c, 505; (17) Thompson and Lucas, 1926, 41; (18) Lucas, 1927a, 220; (19) Lucas, 1928, 161 and 171; (20) McAdow, 1931, 13; (21) Balch, 1932, 237.

Synonymy: *Amoeba blattae*, (1), (2), (4), (5), (6), (7), (8), (10); *Endamoeba blattae*, (2), (13), (15), (16), (17), (18), (19), (20), (21); *Amoeba Blattae*, (3); *Entamoeba blattae*, (9), (11), (12), (14). Yakimoff and Miller (1922a) and Tejera (1926) mention an *Entamoeba battarum* in "*Periplaneta orientalis*" and "*Blattes*," respectively; later corrected by Yakimoff (1922b) and changed to *Entamoeba blattae*. For the same hosts, they give a *Monas* sp. (origin?), Yakimoff and Miller including *Lophomonas blattae* (doubtless *L. blattarum* Stein, 1860) and *Oicomonas* sp. (origin?), and Tejera includes *Oikomonas blattarum* (origin?) and *Plagiostoma blattarum* (undoubtedly *Plagiostoma blattarum* Stein, 1859, now *Nyctotherus ovalis* Leidy, 1850.)

Hosts: (a) *Blatta orientalis* Linnaeus, (1), (4), (5), (6), (9), (10), (11), (13), (15), (17), (19), (20); (b) *Periplaneta americana* (Linnaeus), (19).

Habitat: Alimentary canal, (10a); hind-intestine, (1a), (4a), (5a), (6a), (9a), (11a), (17a); colon, (15a), (20a); rectum, (20a).

Distribution: London, England, (19a); France, (5a), (10a), (11a); Germany, (1a), (4a); Rome, Italy, (6a), (9a); Rovellasca, Italy (?), (3?); Urbana, Illinois, (13a), Baltimore, Maryland, (19b); Ohio, (20a).

Endamoeba thomsoni Lucas, 1927.

References: (1) Lucas, 1927b, 224; (2) Lucas, 1928, 173; (3) Smith and Barret, 1928, 272; (4) Taliaferro, 1928, 274; (5) McAdow, 1931, 14; (6) Balch, 1932, 237.

Synonymy: *Entamoeba thomsoni*, (1), (2), (4), (5); *Endamoeba thomsoni*, (3), (6).

Hosts: (a) *Blattella germanica* (Linnaeus), (5); (b) *Blatta orientalis* Linnaeus, (5); (c) *Periplaneta americana* (Linnaeus), (1), (3), (5).

Habitat: Hind-intestine, (3c); colon and rectum, (5a), (5b), (5c).

Distribution: England, (1c); Charlotte, North Carolina, (3c); Ohio, (5a), (5b), (5c).

Genus 2. *Entamoeba* Casagrandi and Barbagallo, 1895. Nucleus vesicular, membrane thin but distinct. Small endosome. Numerous species in man, mammals and invertebrates.

Entamoeba nana Tejera, 1926.

References: (1) Tejera, 1926, 1382.

Synonymy: Name unchanged.

Hosts: (a) *Blaberus atropos* (Stoll), (1).

Habitat: Alimentary canal, (1a).

Distribution: Venezuela, (1a).

Genus 3. *Endolimax* Kuenen and Swellengrebel, 1917. Nucleus with definite membrane; large, irregular endosome. Small parasitic amoebae.

Endolimax blattae Lucas, 1927.

References: (1) Lucas, 1927a, 220; (2) Lucas, 1927b, 229; (3) Weill, 1929, 23; (4) McAdow, 1931, 21.

Synonymy: Name unchanged.

Hosts: (a) *Blatta orientalis* Linnaeus, (2); (b) *Periplaneta americana* (Linnaeus), (2), (3).

Habitat: Hind-intestine, (2a), (2b); rectum, (3b).

Distribution: England, (2a), (2b); French Indo-China, (3b).

Class 3. SPOROZOA Leuckart, 1879.

Possess no cilia or flagella. Occasionally move about by pseudopodia when immature, but nutrition is by absorption only. Usually non-motile and reproducing by spores.

Subclass 1. TELOSPORIDIA Schaudinn, 1900.

Spores have neither polar capsule nor polar filament. Spore formed at the end of the trophic life and contains one to several sporozoites.

ORDER 1. GREGARINIDA Bütschli, 1882.

Coelozoic parasites in invertebrates. The vast majority do not undergo schizogony.

Tribe 1. Acephalinidea Kolliker, 1848.

Body an unsegmented mass of cytoplasm.

Family 1. Diplocystidae Bhatia, 1930.

Spores spherical or oval, with eight sporozoites.

Genus 1. **Diplocystis** Kunstler, 1887. (Not Penard, 1890. See Cuénot, 1897b.)

Trophozoites fuse precociously to form spherical masses. Coelomic.

Diplocystis schneideri Kunstler, 1887.

References: (1) Kunstler, 1887, 25; (2) Léger, 1892, 45; (3) Labbé, 1899, 46; (4) Magalhães, 1900, 44; (5) Cuénot, 1901, 598; (6) Léger and Duboscq, 1902b, 384; (7) Lühe, 1904, 113, 139; (8) Woodcock, 1904, 127; (9) Schiffman, 1919, 81; (10) Jameson, 1920, 207; (11) Bhatia, 1930, 161.

Synonymy: *Diplocystis schneideri*, (1), (3), (4), (5), (7), (9), (10), (11); *Diplocystis Schneideri*, (2), (6), (8).

Hosts: (a) *Blatta orientalis* Linnaeus, (8), (10); (b) *Periplaneta americana* (Linnaeus), (1), (10).

Habitat: Coelom, (1b), (10a), (10b); posterior mid-intestinal wall, (10a), (10b).

Distribution: London, England, (10a), (10b); France, (1b).

Diplocystis major Cuénot, 1897.

References: (1) Cuénot, 1894, 806; (2) Cuénot, 1895, 321; (3) Cuénot, 1897a, 54; (4) Labbé 1899, 46; (5) Léger and Duboscq, 1900, 1567; (6) Caullery and Mesnil, 1901, 84; (7) Cuénot, 1901, 595; (8) Léger and Duboscq, 1901, 439; (9) Léger and Duboscq, 1902a, 41; (10) Léger and Duboscq, 1902b, 384, 452; (11) Lühe, 1904, 93, 96, 113, 139, 161; (12) Woodcock, 1904, 127; (13) Dogiel, 1909, 201, 206; (14) Wellmer, 1910, 532; (15) Wellmer, 1911, 144.

Synonymy: *Diplocystis* sp., (1); *Diplocystis major*, (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15).

Hosts: (a) *Gryllus domesticus* Linnaeus, (1), (2), (3), (7), (9), (14), (15).

Habitat: Coelom, (1a), (2a), (3a), (7a), (9a), (15a), (8?).

Distribution: East Prussia, (14a), (15a); Altkirch and Roscoff, France, (7a); Ardennes, France, (2a), (3a); Haute-Loire, France, (7a); Joinville and Nancy, France, (3a), (7a).

Diplocystis minor Cuénot, 1897.

References: (1) Cuénot, 1897a, 54; (2) Labbé, 1899, 46; (3) Cuénot, 1901, 595; (4) Léger and Duboscq, 1902b, 385; (5) Lühe, 1904, 113; (6) Woodcock, 1904, 127; (7) Dogiel, 1909, 206.

Synonymy: Name unchanged.

Hosts: (a) *Gryllus domesticus* Linnaeus, (1), (3).

Habitat: Coelom, (1a), (3a).

Distribution: Beauvais and Chauny, France, (1a), (3a); Sauvillie, Villerle-Tilleul, Vendresse, and Nancy, France, (3a).

Tribe 2. Cephalinidea Delage, 1896.

Body divided into two portions by a septum of the ectoplasm.

Family 1. Gregarinidae Labbé, 1899.

Associative or solitary; satellite with septum. Epimerite symmetrical, simple. (In the opinion of the author, the mere observation of cyst development and dehiscence does not give conclusive evidence as to the identity of an adult found

in the same habitat, unless cyst formation is observed, which is rarely the case. Unless the latter phenomenon has been observed, cyst characters are disregarded in the description of new species of Gregarinidae, and they are classified as far as possible on the basis of adult characteristics, comparing them with previously named species. In order to make possible a more accurate classification of Gregarinidae than now exists, it will be necessary to determine methods of culturing species of gregarines so as to obtain them in large numbers, and to perfect a technique for bringing about cyst formation under observation.)

Genus 1. **Leidyana** Watson, 1915. Solitary. Epimerite a simple, globular, sessile knob. Dehiscence by spore ducts. Spores barrel-shaped, in chains.

Leidyana gryllorum (Cuénot, 1897) Watson, 1916.

References: (1) Cuénot, 1897a, 54; (2) Labbé, 1899, 10; (3) Cuénot, 1901, 594; (4) Watson, 1916a, 120; (5) Bhatia and Setna, 1924, 288; (6) This paper, parts II and III.

Synonymy: *Clepsidrina gryllorum*, (1); *Gregarina macrocephala*, (2); *Gregarina gryllorum*, (3); *Leidyana gryllorum*, (4), (5), (6).

Hosts: (a) *Gryllus assimilis* Fabricius, (6); (b) *Gryllus domesticus* Linnaeus, (1), (2), (3); (c) *Gryllus* spp., (5); (d) *Nemobius sylvestris* (Bosc d'Antic), (2); (e) *Nemobius fasciatus fasciatus* (DeGeer), (6).

Habitat: Alimentary canal, (1b), (2b), (2d); gizzard and mid-intestine, (5c); enteric ceca and mid-intestine, (6e); mid-intestine, (3b), (6a).

Distribution: Ardennes, France, (2b), (2d), (1b), (3b); Nancy, Joinville, and Roscoff, France, (3b); Lahore, India, (5c); Franklin and Washington Counties, Ohio, (6a), (6e).

Leidyana erratica (Crawley, 1907) Watson, 1916.

References: (1) Crawley, 1903a, 45; (2) Crawley, 1903b, 639, 641; (3) Crawley, 1907, 221; (4) Ellis, 1913c, 286; (5) Watson, 1915, 35; (6) Watson, 1916a, 118; (7) Kamm, 1922a, 133; (8) Bhatia and Setna, 1924, 288; (9) This paper, parts II and III.

Synonymy: *Gregarina achetaeabbreviatae*, (1), (2); *Stephanophora erratica*, (3), (4); *Leidyana solitaria*, (5); *Leidyana erratica*, (6), (7), (8), (9).

Hosts: (a) *Gryllus assimilis* Fabricius, (3), (5), (6), (9); (b) *Gryllus* spp., (8); (c) *Nemobius fasciatus fasciatus* (DeGeer), (9); (d) *Nemobius fasciatus socius* Scudder, (9); (e) *Anaxipha exigua* (Say), (9); (f) *Hapithus agitator agitator* Uhler, (9).

Habitat: Alimentary canal, (6a); gizzard, (8b); enteric ceca, (9c), (6a); mid-intestine, (8b), (9a), (9c), (9d), (9e), (9f).

Distribution: Lahore, India, (8b); Beach Haven, New Jersey, (3a); Cold Spring Harbor and Oyster Bay, New York, (6a); Champaign County, Ohio, (9d); Franklin County, Ohio, (9a); Delaware County, Ohio, (9e); Washington County, Ohio, (9a), (9c), (9e), (9f).

Genus 2. **Gregarinoides** Fantham, 1925. Biassociative. Epimerite small, globular, or cylindric. Dehiscence by simple rupture.

Gregarinoides locustanae Fantham, 1925.

References: (1) Fantham, 1923, 495; (2) Fantham, 1924, 438; (3) Fantham, 1925, 351; (4) Bush, 1928, 157, et. al.

Synonymy: Reference, but name not used, (1), (2); *Gregarinoides locustanae*, (3), (4).

Hosts: (a) *Locustana pardalina* (F. Walker), (1), (3); (b) 35 ? species of "Acridiidae" common to Natal, South Africa, (4).

Habitat: Mid-intestine, (1a), (3a).

Distribution: Pietermaritzburg, Natal, (4b); Johannesburg, Transvaal, (1a), (3a).

Genus 3. **Gregarina** Dufour, 1828. (Often incorrectly given as 1826.) Biassociative. Epimerite small, globular or cylindric. Dehiscence by spore ducts. Spores barrel-shaped to cylindric.

This classification is based, in part, on the presence of these gregarines in hosts of common classification, i. e., hosts of the same family, etc. This is justifiable inasmuch as these groups of protozoan parasites from related hosts present certain marked resemblances, whether through adaptation or common ancestry.

Division 1. *Actinocephalus*-like sporonts. Hosts, Gryllidae, etc.

Gregarina hyalocephala Dufour, 1837.

References: (1) Dufour, 1837, 13; (2) Siebold, 1839, 70; (3) Frantzius, 1846; (4) Diesing, 1851, 11; (5) Diesing, 1859, 731; (6) Lankester, 1863, 94; (7) Labbé, 1899, 34; (8) Watson, 1916a, 97, 214.

Synonymy: Name unchanged.

Hosts: (a) *Tridactylus variegatus* (Latreille), (1); (b) *Tridactylus* spp., (1).

Habitat: Mid-intestine, (1a), (1b).

Distribution: France, (1a), (1b).

Gregarina conica Dufour, 1837.

References: (1) Dufour, 1837, 12; (2) Siebold, 1839, 70; (3) Desmarest, 1845, 317; (4) Frantzius, ?; (5) Diesing, 1851, 8; (6) Diesing, 1859, 729; (7) Lankester, 1863, 95; (8) Watson, 1916a, 125.

Synonymy: Name unchanged.

Hosts: (a) Gryllidae, spp., (1).

Habitat: Mid-intestine, (1a).

Distribution: France, (1a).

Gregarina oblonga Dufour, 1837.

References: (1) Dufour, 1837, 13; (2) Frantzius, 1846; (3) Frantzius, 1848, 195; (4) Diesing, 1851, 11; (5) Diesing, 1859, 732; (6) Lankester, 1863, 94; (7) Watson, 1916a, 96.

Synonymy: Name unchanged.

Hosts: (a) *Locusta migratoria* Linnaeus, (1); (b) *Acheta campestris* (Linnaeus), (1).

Habitat: Mid-intestine, (1a), (1b).

Distribution: France, (1a), (1b).

Division 2. Gregarine more or less cylindric.

Subdivision 1. Hosts, Blattidae.

Group 1. Gregarine tenuous.

Gregarina panchlorae Frenzel, 1892. Possibly there is a close relationship between this species and *Protomagalhaensia serpentula*.)

References: (1) Frenzel, 1892, 299; (2) Wasielewski, 1896, 138; (3) Labbé 1899, 35; (4) Ellis, 1913c, 265; (5) Watson, 1916a, 103.

Synonymy: Name unchanged.

Hosts: (a) *Panchlora exoleta* Burmeister, (1).

Habitat: Mid-intestine, (1a).

Distribution: Cordoba, Argentina, (1a).

Group 2. Gregarine thick.

Gregarina ohioensis Semans, 1939.

References: (1) This paper, parts II and III.

Hosts: (a) *Parcoblatta virginica* (Brunner), (1).

Habitat: Mid-intestine, (1a).

Distribution: Franklin County, Ohio, (1a).

Gregarina thomasi Semans, 1939.

References: (1) This paper, parts II and III.

Hosts: (a) *Parcoblatta pensylvanica* (DeGeer), (1).

Habitat: Enteric ceca and mid-intestine, (1a).

Distribution: Fairfield County, Ohio (1a).

Gregarina illinensis Watson, 1915.

References: (1) Watson, 1915, 34; (2) Watson, 1916a, 108; (3) Kamm, 1922a, 131; (4) Kamm, 1922b, 84; (5) this paper, part II.

Synonymy: Name unchanged.

Hosts: (a) *Parcoblatta pensylvanica* (DeGeer), (1).

Habitat: Alimentary canal, (1a).

Distribution: Urbana, Illinois, (1a).

Gregarina parcoblattae Semans, 1939.

References: (1) This paper, parts II and III.

Hosts: (a) *Parcoblatta uhleriana* (Saussure), (1); (b) *Parcoblatta pensylvanica* (DeGeer), (1).

Habitat: Mid-intestine, (1a), (1b).

Distribution: Fairfield County, Ohio, (1a), (1b); Franklin County, Ohio, (1b); Washington County, Ohio, (1a).

Gregarina blattarum Siebold, 1839. (*G. blattarum* described by Watson, 1916b, 73, appears to be a variation of that described in Europe, and is referred to elsewhere as "Watson variety" as contrasted with "Old World variety.")

References: (1) Siebold, 1837, 408; (2) Siebold, 1839, 67; (3) Dujardin, 1845, 638; (4) Frantzius, 1846; (5) Frantzius, 1848, 193, 195; (6) Stein, 1848, 223; (7) Diesing, 1851, 10; (8) Leidy, 1853a, 239; (9) Leidy, 1856, 47; (10) Diesing, 1859, 731; (11) Lankester, 1863, 85, 94; (12) Schneider, 1876, 92, etc.; (13) Bütschli, 1881, 385; (14) Schneider, 1882, 424, 442; (15) Balbiani, 1884, 13, 68, 170; (16) Kunstler, 1887, 32, 53; (17) Schneider, 1887, 74, 75; (18) Wolters, 1891, 102, 107, 115, 128, 131; (19) Léger, 1892, 45, 75, 93; (20) Marshall, 1893, 25; (21) Pfeiffer, 1893, 4, 132; (22) Schewiakoff, 1894, 342; (23) Wasielewski, 1896, 34, 136; (24) Schuster, 1898, 244; (25) Labbé, 1899, 35; (26) Magalhães, 1900, 38; (27) Caullery and Mesnil, 1901, 84; (28) Cuénot, 1901, 619; (29) Léger and Duboscq, 1901, 441; (30) Léger and Duboscq, 1902b, 421, 428; (31) Crawley, 1903a, 44; (32) Crawley, 1903b, 639; (33) Lühe, 1904, 118, 134, 139, 172; (34) Hall, 1907, 149, 151, etc.; (35) Léger and Duboscq, 1909, 88, 98; (36) Wellmer, 1910, 531; (37) Wellmer,

1911, 106, 113; (38) Ellis, 1913b, 83; (39) Ellis 1913c, 265; (40) Belar, 1916, 242; (41) Watson, 1916a, 99; (42) Watson, 1916b, 73; (43) Pinto, 1918b, 322; (44) Schiffman, 1919, 79; (45) Laveran and Franchini, 1920b, 332; (46) Kudo, 1922, 113; (47) Tejera, 1926, 1382; (48) Fantham, 1929, 389; (49) McAdow, 1931, 11; (50) this paper, part II.

Synonymy: *Gregarina* sp., (1); *Gregarina blattarum*, (2), (3), (4), (6), (13), (20), (24), (25), (28), (29), (31), (32), (33), (34), (35), (36), (37), (38), (39), (40), (41), (42), (43), (44), (45), (46), (47), (48), (49), (50); *Gregarina Blattarum*, (5), (7), (9), (10), (11), (15); *Gregarina Blattae orientalis*, (8); *Clepsidrina Blattarum*, (12), (15), (17), (18); *Clepsidrina blattarum*, (14), (15), (16), (19), (21), (22), (23), (26), (27), (30); *Gregarina blattae orientalis*, (25).

Hosts: (a) *Parcoblatta pensylvanica* (DeGeer), (14); (b) *Blattella germanica* (Linnaeus), (31), (41); (c) *Blatta orientalis* Linnaeus, (2), (8), (12), (20), (22), (26), (28), (31), (36), (37), (42), (45), (49); (d) *Periplaneta americana* (Linnaeus), (24), (31), (34), (41), (49).

Habitat: Coelom, (26c); alimentary canal, (2c), (8c), (12c), (20c), (31b), (31c), (31d), (42c), (45c); enteric ceca, (26c), (49c), (49d); mid-intestine, (26c), (28c), (49c), (49d).

Distribution: Brazil, (26c); France, (12c), (28c), (45c); East Prussia, (36c); Königsberg, Germany, (37c); Urbana, Illinois, (42c); Douglas Lake, Michigan, (38a); Raleigh, North Carolina, (31b), (31c), (31d); Ohio, (49c), (49d); Wyncote, Pennsylvania, (31b), (31c), (31d).

Subdivision 2. Hosts, Acrididae.

Gregarina rigida columnata Semans, 1939.

References: (1) This paper, parts II and III.

Hosts: (a) *Arphia sulphurea* (Fabricius), (1); (b) *Chortophaga viridifasciata* (DeGeer), (1); (c) *Encopitophus sordidus* (Burmeister), (1); (d) *Pardalophora apiculata* (Harris), (1); (e) *Dissosteira carolina* (Linnaeus), (1); (f) *Spharagemon bolli* Scudder, (1); (g) *S. collare collare* (Scudder), (1); (h) *Melanoplus obovatipennis* (Blatchley), (1); (i) *M. scudderi scudderi* (Uhler), (1); (j) *M. differentialis* (Thomas), (1); (k) *M. bivittatus* (Say), (1); (l) *M. mexicanus mexicanus* (Saussure), (1); (m) *M. keeleri luridus* (Dodge), (1).

Habitat: Base of enteric ceca, (1f), (1h), (1m); enteric ceca and mid-intestine, (1a), (1b), (1c), (1d), (1e), (1g), (1i), (1j), (1k), (1l), (1m).

Distribution: Gary, Indiana, (1g), (1j), (1k); Fairfield County, Ohio, (1a), (1b), (1d), (1i), (1k), (1l), (1m); Franklin County, Ohio, (1c), (1b); Licking County, Ohio, (1e), (1f), (1h), (1m); Union County, Ohio, (1j).

Gregarina rigida rigida (Hall, 1907) Ellis, 1913.

References: (1) Hall, 1907, 150, 169, etc.; (2) Crawley, 1907, 223; (3) Sokolow, 1911, 279; (4) Wellmer, 1911, 108; (5) Ellis, 1913a, 464; (6) Ellis, 1913b, 82; (7) Ellis, 1913c, 267; (8) Watson, 1915, 34; (9) Watson, 1916a, 105; (10) Kamm, 1920, 23; (11) this paper, parts II and III.

Synonymy: *Hirmocystis rigida* (1), (3), (4), (5); *Gregarina melanoplus*, (2), (3), (6); *Gregarina rigida*, (7), (8), (9), (10); *Gregarina rigida rigida*, (11).

Hosts: (a) *Chorthippus curtipennis curtipennis* (Harris), (11); (b) *Arphia sulphurea* (Fabricius), (11); (c) *Encopitophus sordidus* (Burmeister)?, (9); (d) *Dissosteira carolina* (Linnaeus), (11); (e) *Spharagemon bolli* Scudder, (11); (f) *Brachystola magna* (Girard), (5), (7); (g) *Schistocerca americana americana* (Drury)?, (9); (h) *Hesperotettix viridis praeiensis* (Scudder)?, (9); (i) *Melanoplus obovatipennis* (Blatchley), (11); (j) *M. differentialis* (Thomas), (1), (9?), (11); (k) *M. bivittatus* (Say), (1), (2), (6), (9?), (11); (l) *M. femur-rubrum femur-rubrum* (DeGeer), (6), (9), (11); (m) *M. mexicanus mexicanus* (Saussure), (9?), (11); (n) *M. keeleri luridus* (Dodge), (6), (9?), (11); (o) *M. angustipennis* (Dodge), (1), (9?).

Habitat: Alimentary canal, (1j), (1k), (1o); gizzard, (11l); base of ceca, (11i), (11n); enteric ceca, (11a), (11c), (11d), (11j), (11k), (11l), (11m), (9?); mid-intestine, (11a), (11b), (11c), (11d), (11e), (11g), (11l), (11m), (11n).

Distribution: Canon City, Colorado, (1j), (1k), (1o); Colorado Springs, Colorado, (9?); Urbana, Illinois, (9?); Gary, Indiana, (11a), (11d), (11k), (11m); Douglas Lake, Michigan, (6k), (6l), (6n); Lincoln, Nebraska, (9?); Oyster Bay, New York, (9?); Fairfield County, Ohio, (11b), (11e), (11k), (11m), (11n); Franklin County, Ohio, (11c), (11d), (11j), (11l), (11n); Licking County, Ohio, (11i), (11n); Washington County, Ohio, (11j), (11l); Wyncote, Pennsylvania, (2k).

Gregarina indianensis Semans, 1939.

References: (1) This paper, parts II and III.

Hosts: (a) *Chorthippus curtipennis curtipennis* (Harris), (1); (b) *Melanoplus differentialis* (Thomas), (1); (c) *M. bivittatus* (Say), (1); (d) *M. mexicanus mexicanus* (Saussure), (1).

Habitat: Enteric ceca, (1a), (1b), (1c), (1d); mid-intestine, (1a), (1b), (1c), (1d).

Distribution: Gary, Indiana, (1a), (1b), (1c), (1d).

Gregarina nigra Watson, 1915.

References: (1) Watson, 1915, 33; (2) Watson, 1916a, 116; (3) Kamm, 1922a, 130; (4) Kamm, 1922b, 84; (5) Bush, 1928, 154, et. al.; (6) this paper, part II.

Synonymy: Name unchanged.

Hosts: (a) *Encopitophus sordidus* (Burmeister), (1); (b) *Zonocerus elegans* (Thunberg), (5); (c) *Lentula* sp., (5); (d) *Cyrtacanthacris ruficornis* (Fabricius), (5); (e) *Melanoplus differentialis* (Thomas), (3), (4); (f) *M. femur-rubrum femur-rubrum* (DeGeer), (1), (6).

Habitat: Alimentary canal, (5b), (5c), (5d); mid-intestine, (6f).

Distribution: Pietermaritzburg, Natal, (5b), (5c), (5d); Urbana, Illinois, (1a), (1f), (3e), (4e); Washington County, Ohio, (6f).

***Gregarina locustae* Lankester, 1863.**

References: (1) Leidy, 1853a, 239; (2) Leidy, 1856, 47; (3) Diesing, 1859, 730; (4) Lankester, 1863, 94; (5) Léger, 1897, 10; (6) Labbé, 1899, 35; (7) Crawley, 1903a, 54; (8) Crawley, 1903b, 640; (9) Crawley, 1907, 225; (10) Ellis, 1913c, 268; (11) Watson, 1916a, 100; (12) this paper, parts II and III.

Synonymy: *Gregarina Locustae Carolinae*, (1); *Gregarina Locustae carolinae*, (2); *Gregarina fimbriata*, (3); *Gregarina Locustae*, (4), (5); *Gregarina locustae-carolinae*, (6); *Stephanophora locustae-carolinae*, (7), (8); *Gregarina locustae-carolinae*, (9), (10); *Gregarina locustae*, (11), (12).

Hosts: (a) *Dissosteira carolina* (Linnaeus), (1), (9), (12).

Habitat: Alimentary canal, (1a); mid-intestine, (12a).

Distribution: Gary, Indiana, (12a); Wyncote, Pennsylvania, (9a).

***Gregarina paranensis* (Künckel d'Herculais, 1899) Watson, 1916.**

References: (1) Künckel d'Herculais, 1899, 622; (2) Watson, 1916, 104.

Synonymy: *Clepsidrina paranensis*, (1); *Gregarina paranensis*, (2).

Hosts: (a) *Schistocerca paranensis* (Burmeister), (1).

Habitat: Alimentary canal, (1a).

Distribution: Parana, Argentina, (1a).

***Gregarina acridiorum* Léger, 1893.**

References: (1) Léger, 1893, 811; (2) Wasielewski, 1896, 138, 139; (3) Léger, 1897, 27; (4) Labbé, 1899, 10; (5) Léger and Duboscq, 1901, 440, 441; (6) Léger and Duboscq, 1902b, 381, 423, 424, 430, 462; (7) Lühe, 1904, 91, 96, 134; (8) Léger and Duboscq, 1909, 88; (9) Wellmer, 1910, 531; (10) Wellmer, 1911, 112; (11) Watson, 1916a, 104.

Synonymy: *Clepsidrina acridiorum*, (1), (2), (5), (6); *Clepsidrina Acridiorum*, (3); *Gregarina acridiorum*, (4), (5), (6), (7), (8), (9), (10), (11).

Hosts: (a) *Tryxalis* sp., (1), (3); (b) *Oedipoda coerulescens* Linnaeus, (9), (10); (c) *Sphingonotus* sp., (3); (d) *Pamphagus* sp., (1), (3); (e) *Calliptamus italicus* (Linnaeus), (5), (6).

Habitat: Alimentary canal, (1a), (1d) (3a), (3c), (3d), (6e); mid-intestine, (10b).

Distribution: Nemours, Algeria, (1a), (1d); France, (3a), (3c), (3d), (6e); Germany, (9b), (10b).

Subdivision 3. Host, one of the Copiphorinae, subfamily of the Tettigoniidae.

***Gregarina chagasi* Pinto, 1918. (It is singular that this is the only protozoan parasite of any kind described for Tettigoniidae.)**

References: (1) Pinto, 1918a, 49; (2) Pinto, 1919, 81; (3) Kamm, 1922a, 132; (4) Kamm, 1922b, 84.

Synonymy: Name unchanged.

Hosts: (a) *Neoconocephalus fratellus* (Griffini), (1).

Habitat: Alimentary canal, (1a).

Distribution: Manguinhos, Brazil, (1a).

Subdivision 4. Hosts, Gryllidae.

***Gregarina kingi* Crawley, 1907.**

References: (1) Crawley, 1907, 221; (2) Sokolow, 1911, 279; (3) Ellis, 1913c, 271; (4) Watson, 1916a, 106; (5) this paper, parts II and III.

Synonymy: *Gregarina kingi*, (1), (2), (4), (5); *Gigaductus kingi*, (3).

Hosts: (a) *Gryllus assimilis* Fabricius, (1), (5).

Habitat: Alimentary canal, (1a); gizzard, (5a); enteric ceca, (5a); mid-intestine, (5a).

Distribution: Beach Haven, New Jersey, (1a); Franklin and Washington Counties, Ohio, (5a); Wyncote, Pennsylvania, (1a).

***Gregarina galliveri* Watson, 1915.**

References: (1) Watson, 1915, 33; (2) Watson, 1916a, 111; (3) Kamm, 1922a, 130; (4) Kamm, 1922b, 84; (5) this paper, parts II and III.

Synonymy: Name unchanged.

Hosts: (a) *Gryllus assimilis* Fabricius, (1), (2), (5); (b) *Hapithus agitator agitator* Uhler, (5).

Habitat: Alimentary canal, (1a), (2a); crop and gizzard, (5a), (5b); enteric ceca, (5a), (5b); mid-intestine, (5a), (5b).

Distribution: Oyster Bay, New York, (1a), (2a); Franklin County, Ohio, (5a); Washington County, Ohio, (5a), (5b).

Division 3. Complex of structural similarities. Hosts, Raphidophorinae, subfamily of the Gryllacrididae.

***Gregarina hadenoeci* Semans, 1939.**

References: (1) This paper, parts II and III.

Hosts: (a) *Hadenoecus puteanus* Scudder, (1).

Habitat: Mid-intestine, (1a).

Distribution: Washington County, Ohio, (1a).

***Gregarina longiducta* Ellis, 1913.**

References: (1) Ellis, 1913b, 78; (2) Ellis, 1913c, 266; (3) Watson, 1916a, 107; (4) Kamm, 1922a, 129; (5) Kamm, 1922b, 83; (6) this paper, part II.

Synonymy: Name unchanged.

Hosts: (a) *Ceuthophilus pallidipes* E. M. Walker, (erroneously, according to T. H. Hubbell, called *C. maculatus* (Harris)), (1); (b) *Ceuthophilus meridionalis* Scudder, (erroneously, according to Hubbell, called *C. latens* Scudder), (1).

Habitat: Alimentary canal, (1a), (1b).

Distribution: Douglas Lake, Michigan, (1a), (1b).

***Gregarina proteocephala* Semans, 1939.**

References: (1) This paper, parts II and III.

Hosts: (a) *Ceuthophilus gracilipes* (Haldeman), (1).

Habitat: Mid-intestine, (1a).

Distribution: Washington County, Ohio, (1a).

***Gregarina stygia* Watson, 1915.**

References: (1) Watson, 1915, 33; (2) Watson, 1916a, 114; (3) Kamm, 1922a, 131; (4) Kamm, 1922b, 83; (5) this paper, part II.

Synonymy: Name unchanged.

Hosts: (a) Probably *Ceuthophilus gracilipes* (Haldeman), erroneously called *C. stygia* (Scudder), according to T. H. Hubbell. (1), (4).

Habitat: Alimentary canal, (1a).

Distribution: Cold Spring Harbor, New York, (1a).

***Gregarina consobrina* Ellis, 1913.**

References: (1) Ellis, 1913c, 267; (2) Watson, 1916a, 108; (3) Kamm, 1922a, 128; (4) Kamm, 1922b, 83; (5) this paper, part II.

Synonymy: Name unchanged.

Hosts: (a) *Ceuthophilus uniformis* Scudder, (1).

Habitat: ?

Distribution: Near Boulder, Colorado, (1a).

***Gregarina* sp.**

References: (1) This paper, parts II and III.

Hosts: (a) *Ceuthophilus divergens* Scudder, (1).

Habitat: Mid-intestine, (1a).

Distribution: Franklin County, Ohio, (1a).

***Gregarina neglecta* Watson, 1916.**

References: (1) Watson, 1916b, 69; (2) Kamm, 1922a, 131; (3) Kamm, 1922b, 83; (4) this paper, part II.

Synonymy: Name unchanged.

Hosts: (a) Uncertain. *Ceuthophilus nigricans* Scudder, or, possibly, *Ceuthophilus brevipes* Scudder, or? (According to T. H. Hubbell.), (1).

Habitat: ? (1a).

Distribution: Oyster Bay, New York, (1a).

***Gregarina ceuthophili* Semans, 1939.**

References: (1) This paper, parts II and III.

Hosts: (a) *Ceuthophilus gracilipes* (Haldeman), (1); (b) *Ceuthophilus brevipes* Scudder, (1); (c) *Ceuthophilus divergens* Scudder, (1).

Habitat: Mid-intestine, (1a), (1b), (1c).

Distribution: Fairfield and Washington Counties, Ohio, (1a); Franklin County, Ohio, (1c); Licking County, Ohio, (1b).

***Gregarina prima* Semans, 1939.**

References: (1) This paper, parts II and III.

Hosts: (a) *Ceuthophilus uhleri* Scudder, (1).

Habitat: Mid-intestine, (1a).

Distribution: Fairfield and Logan Counties, Ohio, (1a).

***Gregarina udeopsyllae* Watson, 1916.**

References: (1) Watson, 1916a, 117; (2) Kamm, 1922a, 131; (3) Kamm, 1922b, 84; (4) this paper, part II.

Synonymy: Name unchanged.

Hosts: (a) *Udeopsylla robusta* (Haldeman), (1).

Habitat: Mid-intestine, (1a).

Distribution: Urbana, Illinois, (1a).

Division 4. *Leidyana*-like cephalont. Hosts, Gryllidae.

***Gregarina macrocephala* (Schneider, 1875) Labbé, 1899.**

References: (1) Schneider, 1876, 18, 19, 32, 86; (2) Schneider, 1882, 442; (3) Schneider, 1885,

25; (4) Kunstler, 1887, 47; (5) Schneider, 1887, 73; (6) Léger, 1892, 67; (7) Léger, 1893, 811; (8) Wasielewski, 1896, 34, 137; (9) Cuénot, 1897, 54; (10) Léger, 1897, 10; (11) Labbé, 1899, 10; (12) Cuénot, 1901, 595; (13) Lühe, 1904, 139, 149; (14) Watson, 1916a, 102.

Synonymy: *Clepsidrina macrocephala*, (1), (2), (3), (4), (5), (6), (7), (8), (10); *Clepsidrina gryllorum*, (9); *Gregarina macrocephala*, (11), (12), (13), (14).

Hosts: (a) *Acheta campestris* (Linnaeus), (1); (b) *Gryllus domesticus* Linnaeus, (9), (11); (c) *Nemobius sylvestris* (Bosc d'Antic), (2), (11).

Habitat: Alimentary canal, (2c), (9b), (11b), (11c).

Distribution: France, (1a), (2c); Ardennes, France, (9b).

Division 5. Protomerite of satellite almost obliterated. Hosts, Acrydiinae, subfamily of Acrididae.

***Gregarina acrydiinarum* Semans, 1939.**

References: (1) This paper, parts II and III.

Hosts: (a) *Achydium arenosum angustum* Hancock, (1); (b) *Paratettix cucullatus cucullatus* (Burmeister), (1).

Habitat: Mid-intestine, (1a), (1b).

Distribution: Franklin County, Ohio, (1a); Delaware County, Ohio, (1b).

Division 6. Relationships not apparent.

***Gregarina oviceps* Diesing, 1859.**

References: (1) Leidy, 1853a, 238; (2) Leidy, 1856, 47; (3) Diesing, 1859, 728; (4) Lankester, 1863, 94; (5) Labbé 1899, 35; (6) Crawley, 1903a, 45; (7) Crawley, 1903b, 639; (8) Crawley, 1907, 220; (9) Ellis, 1913c, 266; (10) Watson, 1915, 34; (11) Watson, 1916a, 101; (12) Bhatia and Setna, 1924, 287; (13) this paper, parts II and III.

Synonymy: *Gregarina Achetae abbreviatae*, (1), (2); *Gregarina oviceps*, (3), (11), (12), (13); *Gregarina Achetae*, (4); *Gregarina achetaeabbreviatae*, (5), (6), (7); *Gregarina achetae-abbreviatae*, (8), (9), (10).

Hosts: (a) *Gryllus assimilis* Fabricius, (1), (8), (9), (11), (13); (b) *Gryllus* spp., (12).

Habitat: Alimentary canal, (11a); gizzard, (1a), (12b), (13a); mid-intestine, (12b), (13a).

Distribution: Lahore, India, (12b); Urbana, Illinois, (11a); Douglas Lake, Michigan, (9a); Beach Haven, New Jersey, (8a); Oyster Bay, New York, (11a); Franklin and Washington Counties, Ohio, (13a); Haverford and Philadelphia, Pennsylvania, (11a); Wyncote, Pennsylvania, (8a).

***Gregarina davini* Léger and Duboscq, 1899.**

References: (1) Léger and Duboscq, 1899, 38; (2) Léger and Duboscq, 1902b, 380, 461; (3) Mercier, 1908a, 377; (4) Sokolow, 1911, 278; (5) Watson, 1916a, 126.

Synonymy: *Gregarina Davini*, (1), (2), (5); *Clepsidrina davini*, (3); *Gregarina davini*, (4).

Hosts: (a) *Grylломорpha dalmatina* (Ocskay de Ocskó), (1).

Habitat: Mid-intestine, (1a).

Distribution: France ?, (1a).

***Gregarina ovata* Dufour, 1828.**

References: (1) Dufour, 1828, 367; (2) Dufour, 1837, 12; (3) Siebold, 1837, 408; (4) Hammerschmidt, 1838; (5) Desmarest, 1845, 317; (6) Frantzius, 1846; (7) Frantzius, 1848, 194, 195; (8) Diesing, 1851, 10; (9) Leidy, 1853a, 233; (10) Diesing, 1859, 731; (11) Lankester, 1863, 94; (12) Schneider, 1873, 515; (13) Schneider, 1876, 90; (14) Schneider, 1882, 442; (15) Balbiani, 1884, 13; (16) Schneider, 1885, 25; (17) Wasielewski, 1896, 22, 33, 137; (18) Labbé, 1899, 10; (19) Paehler, 1904, 64; (20) Schnitzler, 1905, 309; (21) Léger and Duboscq, 1909, 85; (22) Brindley and Potts, 1910, 836; (23) Wellmer, 1910, 531; (24) Wellmer, 1911, 106, 111; (25) Ellis, 1913c, 265; (26) Watson, 1916a, 97; (27) Brindley, 1918, 167; (28) Schiffman, 1919, 84; (29) this paper, part II.

Synonymy: *Gregarina ovata*, (1), (2), (3), (5), (6), (7), (8), (9), (10), (11), (12), (15), (18), (19), (21), (22), (23), (24), (25), (26), (28), (29); *Clepsidrina conoidea*, (4); *Clepsidrina ovata*, (13), (14), (16), (17), (20), (27).

Hosts: (a) *Acheta campestris* (Linnaeus), (2); (b) *Forficula auricularia* Linnaeus. (This insect belongs to the family Forficulidae of the Dermaptera, formerly, but no longer, included in the Orthoptera.) (1), (12), (13), (19), (20), (23), (24), (27); (c) *Forficula* sp., (22).

Habitat: Alimentary canal, (1b), (19b), (20b), (22c), (24b), (27b); mid-intestine, (12b).

Distribution: France, (1b), (13b); East Prussia, (23b); Marburg, Germany, (20b); St. Marys, Isles of Scilly, (27b); Farne Islands, (22c).

***Gregarina legeri* Pinto, 1918.**

References: (1) Pinto, 1918a, 113; (2) Pinto, 1918b, 322; (3) Pinto, 1919, 86; (4) Kamm, 1922a, 140.

Synonymy: Name unchanged.

Hosts: (a) *Periplaneta americana* (Linnaeus), (1).

Habitat: Alimentary canal, (1a).

Distribution: Rio de Janeiro, Brazil, (1a).

Gregarina sphaerulosa Dufour, 1837. (Only cyst is known.)

References: (1) Dufour, 1837, 12; (2) Frantzius, 1846; (3) Diesing, 1851, 11; (4) Diesing, 1859, 732; (5) Lankester, 1863, 94; (6) Léger, 1892, 112; (7) Labbé, 1899, 13; (8) Watson, 1916a, 126.

Synonymy: *Gregarina sphaerulosa*, (1), (3), (4), (5), (8); *Eirmocystis gryllotalpae*, (6); *Hirmocystis gryllotalpae*, (7).

Hosts: (a) *Gryllotalpa* spp., (1); (b) *Oedipoda* spp., (1).

Habitat: Mid-intestine, (1a), (1b).

Distribution: France: (1a), (1b).

Genus 4. **Protomagalhaensia** Pinto, 1918. Spores barrel-shaped with spine at each corner. Sporonts attenuated, several individuals in association, often attached laterally.

Protomagalhaensia serpentula (Magalhães, 1900) Pinto, 1918.

References: (1) Magalhães, 1900, 43; (2) Sokolow, 1911, 278; (3) Ellis, 1913c, 266; (4) Watson, 1916a, 104; (5) Pinto, 1918b, 321; (6) Kamm, 1922a, 133.

Synonymy: *Gregarina serpentula*, (1), (2), (3), (4); *Protomagalhaensia serpentula*, (5), (6).

Hosts: (a) *Periplaneta americana* (Linnaeus), (1).

Habitat: Coelom and alimentary canal, (1a).

Distribution: Rio de Janeiro, Brazil, (1a).

Genus 5. **Gamocystis** Schneider, 1875. Associative. Protomerite only in young stages. Sporulation partial, with spore ducts. Spores cylindric.

Gamocystis tenax Schneider, 1875.

References: (1) Schneider, 1876, 99, etc.; (2) Schneider, 1882, 444, 445; (3) Balbiani, 1884, 13, 50; (4) Wasielewski, 1896, 36, 136; (5) Labbé, 1899, 12; (6) Lühe, 1904, 155; (7) Wellmer, 1910, 532; (8) Wellmer, 1911, 108, 122; (9) Ellis, 1913c, 271; (10) Watson, 1916a, 122.

Synonymy: Name unchanged.

Hosts: (a) *Ectobia lapponica* (Linnaeus), (1), (7), (8).

Habitat: Alimentary canal, (1a), (8a).

Distribution: France, (1a); East Prussia, (7a); Germany, (8a).

Genus 6. **Tettigonospora** Smith, 1930. Associative. Dehiscence by spore ducts. Spores spherical.

Tettigonospora stenopelmatis (Smith, 1929) Smith, 1930.

References: (1) Smith, 1929, 57; (2) Smith, 1930, 445.

Synonymy: *Coccospora stenopelmatis*, (1); *Tettigonospora stenopelmatis*, (2).

Hosts: (a) *Stenopelmatus pictus* Scudder, (1); (b) *Stenopelmatus fuscus* Haldeman, (1); (c) *Stenopelmatus intermedius* Davis and Smith, (2).

Habitat: Ceca and mid-intestine, (1a), (1b); excrement, (2c).

Distribution: Central California, (1a), (1b); Oakland, California, (2c).

Genus 7. **Hirmocystis** Labbé, 1899. Associations of from 2 to 12 or more. Epimerite a small, cylindric papilla. Cysts dehiscence by simple rupture. Spores ovoid.

Hirmocystis gryllotalpae (Léger, 1892) Labbé, 1899.

References: (1) Léger, 1892, 112; (2) Wasielewski, 1896, 35; (3) Léger, 1897, 11; (4) Labbé, 1899, 13; (5) Watson, 1916a, 123.

Synonymy: *Gregarina sphaerulosa*, (1), (4); *Eirmocystis gryllotalpae*, (1), (2); *Eirmocystis Gryllotalpae*, (3); *Hirmocystis gryllotalpae*, (4), (5).

Hosts: (a) "Courtilieres" (a gryllid), (1).

Habitat: Alimentary canal, (1a).

Distribution: Vallee du Clain, Poitou, France, (1a).

Family 2. **Actinocephalidae** Léger, 1892.

Sporonts solitary. Epimerite varied. Cysts dehiscence by simple rupture. Spores irregular, biconic, or cylindro-biconic.

Genus 1. **Pileocephalus** Schneider, 1875. Epimerite a lance-shaped or simple cone. Spores ovoid, pointed.

Pileocephalus tachycines Semans, 1939.

References: (1) This paper, parts II and III.

Hosts: (a) *Tachycines asinamorus* (Adelung), (1).

Habitat: Mid-intestine, (1a).

Distribution: Franklin County, Ohio, (1a).

Pileocephalus blaberae (Frenzel, 1892) Labbé, 1899.

References: (1) Frenzel, 1892, 300; (2) Wasielewski, 1896, 136; (3) Labbé, 1899, 20; (4) Ellis, 1913c, 266; (5) Watson, 1916a, 123; (6) This paper, part II.

Synonymy: *Gregarina blaberae*, (1), (2), (4); *Pileocephalus blaberae*, (3), (5), (6).

Hosts: (a) *Blaphica dubia* (Serville), and related species, (1).

Habitat: Mid-intestine, (1a).

Distribution: Cordoba, Argentina, (1a).

Genus 2. **Actinocephalus** Stein, 1848. Epimerite small, sessile or on a short neck, with 8 or 10 short, sharp spines or simple, bifurcate digitiform processes. Spores biconic.

Division 1. South African species.

Actinocephalus giganteus Bush, 1928.

References: (1) Bush, 1928, 149, et. al.

Synonymy: Name unchanged.

Hosts: (a) "Majority of the grasshopper species." (This refers to 35 ? species of "Acridiidae" examined by Bush.) "... did not occur in *Locustana pardalina*," (1).

Habitat: Alimentary canal, (1a).

Distribution: Pietermaritzburg, Natal, (1a).

Actinocephalus sp. Bush, 1928.

References: (1) Bush, 1928, 152, et. al.

Hosts: (a) *Parga xanihoptera* (Stal), (1); (b) *Catantops humeralis* (Thunberg), (1).

Habitat: Alimentary canal, (1a), (1b).

Distribution: Pietermaritzburg, Natal, (1a), (1b).

Actinocephalus amphoriformis Bush, 1928.

References: (1) Bush, 1928, 149, et. al.

Synonymy: Name unchanged.

Hosts: (a) "Practically all the species of grasshoppers." (This refers to 35 ? species of "Acridiidae" examined by Bush.) "... did not occur in *Locustana pardalina*," (1).

Habitat: Alimentary canal, (1a).

Distribution: Pietermaritzburg, Natal, (1a).

Division 2. North American species.

Actinocephalus sp.

References: (1) This paper, parts II and III.

Hosts: (a) *Pardalophora apiculata* (Harris), (1).

Habitat: Mid-intestine, (1a).

Distribution: Washington County, Ohio, (1a).

Actinocephalus fimbriatus (Diesing, 1859) Watson, 1916.

References: (1) Leidy, 1853a, 239; (2) Leidy, 1856, 47; (3) Diesing, 1859, 730; (4) Crawley, 1903a, 54; (5) Crawley, 1903b, 640; (6) Crawley, 1907, 226; (7) Ellis, 1913c, 278; (8) Watson, 1916a, 124; (9) this paper, part II.

Synonymy: *Gregarina Locustae carolinae*, (1); *Gregarina Locustae carolinae*, (2); *Gregarina fimbriata*, (3); *Stephanophora locustaeacarinae*, (4), (5); *Stephanophora pachyderma*, (6); *Actinocephalus pachydermus*, (7); *Actinocephalus fimbriatus*, (8), (9).

Hosts: (a) *Dissosteira carolina* (Linnaeus), (1), (6).

Habitat: Alimentary canal, (1a).

Distribution: Wyncote, Pennsylvania, (6a).

Actinocephalus elongatus Semans, 1939.

References: (1) This paper, parts II and III.

Hosts: (a) *Dichromorpha viridis* (Scudder), (1); (b) *Arphia sulphurea* (Fabricius), (1); (c) *Chortophaga viridifasciata* (DeGeer), (1); (d) *Schistocerca americana americana* (Drury), (1, A. *elongatus* ?); (e) *Melanoplus mexicanus mexicanus* (Saussure), (1, A. *elongatus* ?).

Habitat: Coelom, (1c); enteric ceca, (1c), (1b); mid-intestine, (1a), (1c), (1d).

Distribution: Fairfield County, Ohio, (1c); Franklin County, Ohio, (1d); Washington County, Ohio, (1a), (1b), (1c).

Genus 3. **Legeria** Labbé, 1899. Epimerite not known. Protomerite dilated and massive. Septum convex upward. Spores cylindro-conic.

Legeria sp. Bush, 1928. (Possibly the immature of the South African *Gregarina nigra* Watson.

See this paper, part II, under *Gregarina indianensis* n. sp.)

References: (1) Bush, 1928, 153, et. al.

Hosts: (a) *Phloeonotus jugatus* (F. Walker), (1).

Habitat: Alimentary canal, (1a).

Distribution: Pietermaritzburg, Natal, (1a).

Subclass 2. **NEOSPORIDIA** Schaudinn, 1900.

Spores formed more or less continuously throughout the trophic stages, the sporoblasts being carried about with the organism, which may ultimately become a huge mass of spores.

Order 1. MICROSPORIDIA Balbiani, 1884.

Small spores, frequently less than 5 microns in length. Possess one, or exceptionally, two polar capsules, which under pressure extrude exceedingly long filaments.

Family 1. *Nosematidae* Labbé, 1899.

Ovoid or pyriform spores developed from uninucleate rounded bodies which are the products of multiple or binary fission of the vegetative forms.

Genus 1. *Plistophora* Gurley, 1893. Each sporont gives rise to many spores, more than 16.

Plistophora periplanetae (Lutz and Splendore, 1903) Perrin, 1905.

References: (1) Schaudinn, 1902, 309; (2) Lutz and Splendore, 1903, 154; (3) Perrin, 1905, 204; (4) Mercier, 1906a, 1083; (5) Perrin, 1906, 615; (6) Mercier, 1908a, 373; (7) Mercier, 1908c, 41; (8) Shiwago, 1909, 647; (9) Wellmer, 1910, 532; (10) Epstein, 1911, 677; (11) Shiwago, 1911, 49; (12) Wellmer, 1911, 145; (13) Swarczewsky, 1914, 50, 74, 91; (14) Georgévitch, 1925a, 1191; (15) Georgévitch, 1925b, 102, 104; (16) Georgévitch, 1927, 9.

Synonymy: Not named, (1); *Nosema periplanetae*, (2); *Pleistophora periplanetae*, (3), (5), (8), (9), (10), (11), (12), (13), (14), (15); *Plistophora periplanetae*, (4), (7), (16), (17).

Hosts: (a) *Blattella germanica* (Linnaeus), (12); (b) *Blatta orientalis* Linnaeus, (3), (4), (8), (9), (10), (12), (14); (c) *Periplaneta americana* (Linnaeus), (2); (d) "Blattes," (15).

Habitat: Alimentary canal, (2c); Malpighian tubules, (3b), (4b), (8b), (10b), (12a), (12b), (15d).

Distribution: Brazil, (2c); England, (3b); France, (4b); Königsberg, Germany, (12b); Munich, Germany, (10b); East Prussia, (9b); Moscow, Russia, (8a), (8b), (10b); Belgrade, Yugoslavia, (14b).

Species related to *Plistophora periplanetae* (Lutz and Splendore, 1903) mentioned by Lutz and Splendore, 1903.

References: (1) Lutz and Splendore, 1903, 154.

Hosts: (a) *Grylotalpa* sp., (1).

Habitat: Mid-intestine, wall, (1a).

Distribution: Brazil, (1a).

Species related to *Plistophora periplanetae* (Lutz and Splendore, 1903) mentioned by Perrin, 1905.

References: (1) Perrin, 1905, 208.

Hosts: (a) *Blatta orientalis* Linnaeus, (1).

Habitat: Malpighian tubules, (1a).

Distribution: England, (1a).

***Plistophora* sp.** Mercier.

References: (1) Mercier, 1908, 373; (2) Kudo, 1924, 178.

Hosts: (a) *Blatta orientalis* Linnaeus, (1).

Habitat: Fat bodies, (1a).

Distribution: ?

Order 2. HAPLOSPORIDIA Lühe, 1900.

Spores spherical or ovoid, the surface variously marked with ridges, but without polar capsules. Possess a tail-like process in some cases.

Genus 1. *Coelosporidium* Mesnil and Marchoux, 1897. Body small, forming cysts. Spore without a filament.

Coelosporidium periplanetae (Lutz and Splendore, 1903) Swarczewsky, 1914.

References: (1) Lutz and Splendore, 1903, 154; (2) Crawley, 1905, 158; (3) Caullery and Mesnil, 1905, 108, 160; (4) Dofflein, 1909, 816; (5) Wellmer, 1911, 146; (6) Swarczewsky, 1914, 91, 101, 104; (7) Kudo, 1922, 113; (8) Kudo, 1924, 188; (9) Georgévitch, 1927, 9; (10) Kudo, 1931, 332.

Synonymy: *Nosema periplanetae*, (1); *Coelosporidium blattellae*, (2), (3); *Bertramia blattellae*, (4), (5); *Coelosporidium periplanetae*, (6), (7), (8), (9), (10).

Hosts: (a) *Blattella germanica* (Linnaeus), (2), (5); (b) *Blatta orientalis* Linnaeus, (7).

Habitat: Malpighian tubules, (2a), (5a).

Distribution: Königsberg, Germany, (5a); United States, (2a); Urbana, Illinois, (7b).